



**University of
Zurich**^{UZH}

**Zurich Open Repository and
Archive**

University of Zurich
University Library
Strickhofstrasse 39
CH-8057 Zurich
www.zora.uzh.ch

Year: 2011

Wage traps as a cause of illiteracy, child labor, and extreme poverty

Gärtner, Dennis ; Gärtner, Manfred

Abstract: When labor incomes approach subsistence levels, the labor supply curve slopes outward, because the fight for survival mandates households to look for longer work hours in response to falling wage rates. We explore conditions under which near-subsistence scenarios may imply wage traps, labor market failures that can be the cause of undernourishment, illiteracy, and child labor. After stating general conditions under which wage traps occur, we look at specific production functions typically employed in quantitative analyses of growth and development. We find that standard Cobb-Douglas production functions do not permit wage traps, whereas CES functions do. Beyond that it turns out that when subsistence requirements increase with work hours, and when work effort rises with the wage rate, up to the efficiency-wage threshold, wage traps become more likely. Measures such as bans on child labor, implementation of minimum wage laws, or the establishment of labor unions may quite effectively improve conditions in wage-trapped labor markets.

DOI: <https://doi.org/10.1016/j.rie.2010.10.003>

Posted at the Zurich Open Repository and Archive, University of Zurich

ZORA URL: <https://doi.org/10.5167/uzh-40883>

Journal Article

Accepted Version

Originally published at:

Gärtner, Dennis; Gärtner, Manfred (2011). Wage traps as a cause of illiteracy, child labor, and extreme poverty. *Research in Economics*, 65(3):232-242.

DOI: <https://doi.org/10.1016/j.rie.2010.10.003>

Accepted Manuscript

Wage traps as a cause of illiteracy, child labor, and extreme poverty

Dennis Gärtner, Manfred Gärtner

PII: S1090-9443(10)00065-7

DOI: [10.1016/j.rie.2010.10.003](https://doi.org/10.1016/j.rie.2010.10.003)

Reference: YREEC 481

To appear in: *Research in Economics*

Received date: 23 December 2009

Accepted date: 30 October 2010



Please cite this article as: Gärtner, D., Gärtner, M., Wage traps as a cause of illiteracy, child labor, and extreme poverty. *Research in Economics* (2010), doi:10.1016/j.rie.2010.10.003

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Wage Traps as a Cause of Illiteracy, Child Labor, and Extreme Poverty

Dennis Gärtner* and Manfred Gärtner†

August 2010

Abstract

When labor incomes approach subsistence levels, the labor supply curve slopes outward, because the fight for survival mandates households to look for longer work hours in response to falling wage rates. We explore conditions under which near-subsistence scenarios may imply wage traps, labor market failures that can be the cause of undernourishment, illiteracy, and child labor. After stating general conditions under which wage traps occur, we look at specific production functions typically employed in quantitative analyses of growth and development. We find that standard Cobb-Douglas production functions do not permit wage traps, whereas CES functions do. Beyond that it turns out that when subsistence requirements increase with work hours, and when work effort rises with the wage rate, up to the efficiency-wage threshold, wage traps become more likely. Measures such as bans on child labor, implementation of minimum wage laws, or the establishment of labor unions may quite effectively improve conditions in wage-trapped labor markets.

JEL Classification: J2, J4, O11

Keywords: Subsistence income, labor supply, poverty, child labor, wage trap, market failure

*Socioeconomic Institute, University of Zurich, Blümlisalpstrasse 10, 8006 Zürich, Switzerland; dennis.gaertner@soi.uzh.ch.

†Corresponding author. Institute of Economics, University of St. Gallen, Bodanstrasse 1, St. Gallen, Switzerland; manfred.gaertner@unisg.ch.

1 Introduction

There is a lengthy discussion on record in the history of economic thought concerning the possibility and implications of a backward-bending labor-supply curve.¹ The typical example of a negatively-sloped labor supply curve occurs at high wage rates and incomes, and is of little interest from the perspective of poor countries with insufficient development dynamics. The other end of the wage spectrum has received much less attention. When wages are very low and labor incomes approach subsistence levels, the need to keep heads above water simply in order to survive renders the slope of the labor supply curve negative as well. In this situation the fight for physical survival dominates all other considerations, such as the consumption/leisure trade-offs embedded in standard utility functions, and forces households to look for longer work hours in response to falling wage rates.

The first paper to address the issue of negatively sloped, or ‘outward-sloping’ labor supply curves in poor countries or industries from an economic perspective appears to be Krueger (1962). This is underscored by the fact this short, 2-page text does not cite any prior work in addition to Samuelson’s (1947) masterpiece. Krueger is mainly interested in the effect of outward-sloping labor supply on capital formation and rules out the existence of multiple equilibria by assumption. Picking up the topic a decade later, Barzel and McDonald extend the argument by introducing wealth and demonstrate that lack of sufficient assets to provide for survival is a sufficient condition for a negatively sloped labor supply curve at low wage rates. When Dessing (2002)² revived interest in the topic, she also focused on the theoretical underpinnings of the outward-sloping segment of the labor supply curve, but, again, did not discuss the interplay with labor demand and the possibility of multiple labor market equilibria. Prasch (2000) did add a labor demand curve to his version of a ‘revised labor supply schedule’ and point to the possibility of multiple equilibria. His discussion remained verbal and vague, however, and multiple equilibria are *assumed* rather than derived, and their implications are not really explored.

¹The traditional explanation of the backward-bending labor supply curve is based on the premise that beyond a certain wage threshold, the income effect dominates the substitution effect. More recent contributions look at other possible explanations. For example, Lin (2003) derives a backward-bending segment of the labor supply curve without an income effect by treating work effort and work hours as distinct variables in an efficiency wage model.

²Even though this paper was published as late as 2002, its main arguments already feature in the author’s doctoral dissertation submitted more than a decade earlier. See Dessing (1990).

The first full-fledged discussion of multiple labor market equilibria and their policy implications was offered by Basu and Van (1999). There also, however, multiple equilibria are conceded to be a possibility and then *assumed* to exist, without really exploring the conditions under which this might be the case.³

Our paper attempts to fill this gap. Specifically, and most importantly, we move beyond the straightforward formulation of generic conditions for multiple equilibria by looking at specific production functions and subsistence constraints. The important insight derived from this endeavor is that low-wage traps which may come with multiple labor market equilibria and may be at the root of problems such as child labor, undernourishment or widening income distributions, can have a variety of causes. This implies that one-size-fits-all policy recommendations may be misleading and need to be replaced by a careful examination of the specifics of the wage trap at hand. If such wage traps only exist in small, low-wage sectors of an otherwise developed economy, chirurgic policy measures such as minimum wage laws may be called for and suffice. If wage traps are characteristic of major parts of a low-income economy, foreign aid of the big-push variety may be called for, as is often suggested in the literature on poverty traps.⁴

The remainder of this paper is organized as follows. Section 2 gives a brief introduction to labor markets with a Z-shaped labor supply curve and sets the stage for the subsequent analysis. Section 3 formulates generic conditions for the emergence of path-dependent labor market equilibria that may include wage traps. In section 4 we become more specific by asking whether production functions that feature most prominently in applied research permit wage traps. The obtained results are subjected to robustness checks in section 5 where we permit subsistence levels and the efficiency of labor to be endogenous. Section 6 offers a concise overview of the empirical literature on labor supply schedules in poor countries, and discusses its relevance for the theoretical discussions of this paper. Section 7 contains a brief discussion of policy measures. Finally, section 8 sums up and offers an outlook on

³What is puzzling is that Basu and Van (1999) does not contain a reference to any of the earlier papers mentioned in this paragraph. This perplexes all the more as in an ensuing exchange Swinnerton and Rogers (1999) and Basu and Van (1999) discuss to what extent redistributive policies may serve to eliminate child labor, an issue already addressed by Barzel and McDonald (1973) in indirect form.

⁴The most comprehensive survey on poverty traps is Azariadis and Stachurski (2005), which draws on Azariadis (1996, 2004). A recent empirical study on the relevance of two specific kinds of poverty traps, with negative results, is Kraay and Raddatz (2006).

future research.

2 Outward-Sloping Labor Supply and Wage Traps

The existence of a negatively sloped labor supply curve near subsistence levels is not a serious problem per se. Consider Figure 1, where the bold line shows a complete labor supply curve and helps put the issue at hand in perspective. It has been coined the S-shaped labor supply curve or, more correctly, the *inverted* S-shaped labor demand curve. Most fitting, perhaps, is the term ‘Z-shaped labor supply curve’ suggested by Grimsrud (2003). It includes the familiar backward-bending segment at high wage rates, the normal positively-sloped middle part, and the negatively-sloped segment near the bottom. To distinguish this segment from the backward-bending segment on top, this section is often called the ‘outward sloping’ (or ‘forward falling’) part of the labor supply curve.

[Figure 1 near here]

A simple but straightforward way to rationalize this Z-shape is by proposing that households choose consumption $C \geq 0$ and their supply of labor $L \in [0, \bar{L}]$ so as to maximize the utility function

$$U = U(C, \bar{L} - L) \times S,$$

subject to the budget constraint $C = w \cdot L$, where $U(\cdot) > 0$ and where

$$S = \begin{cases} 1 & \text{if } wL \geq \text{MIN}, \\ 0 & \text{if } wL < \text{MIN}. \end{cases}$$

The backward bend for high wage levels would result from appropriate properties of the utility function $U(\cdot)$. The outward-sloping segment for low wage levels in turn obtains because utility drops to zero when income falls short of the subsistence level. In order to avoid this, any drop in the wage rate mandates an appropriate increase in work hours offered to firms.⁵

⁵The less than elegant kink in the labor supply curve results from our attempt to provide a parsimonious and intuitive formal model of the Z-shaped labor supply curve that makes the subsistence level threshold explicit. For a smoother transition from the positively-sloped to the outward-sloping segment, one might let S be a continuous variable in the interval $[0, 1]$ that measures health, and make it depend on labor income. We do not need to complicate things this way, since this paper’s focus is on labor market equilibria effectively positioned *on* the subsistence level supply curve and on the properties of such scenarios.

On a related point, one might imagine the outward slope in the supply curve commencing already at wage levels where sheer survival and health are not as immediately at stake, but where households simply prefer to compensate income losses with additional work hours. Sharif (1991), for instance, proposes an outward-sloping labor supply curve based on a utility function with a varying elasticity of substitution between consumption and leisure, or food and rest time, in his terminology. Again, abstracting from this issue is innocuous to the extent that our ensuing analysis will focus on the outward-sloping part of the supply curve and, more specifically, on wage levels which are so low that labor supply is indeed governed entirely by subsistence needs.

In the situation depicted in Figure 1, the subsistence-level equilibrium in A is stable, and as technological progress and capital accumulation tilt the labor demand curve upward, two things happen. First, the welfare of workers and their families improves, because while consumption initially remains stuck at the level required for subsistence, work time falls and leisure time increases. This has the added benefit of providing workers with more time to invest in their human capital, which spurs labor productivity growth and accelerates the shift of the labor demand curve. Second, the equilibrium will eventually cross the kink in the labor supply curve and labor income will begin to grow along the positively-sloped segment of the labor supply curve, benefiting from productivity increases.

[Figure 2 near here]

The case shown in Figure 2 is more dramatic. Here the labor market features multiple equilibria. The one in the middle, marked by point A, occurs at the wage rate w_T . Since A is located at the point of intersection between the labor demand curve and the subsistence segment of the labor supply curve, labor income just equals subsistence income. Because the supply curve is flatter than the demand curve, this equilibrium is not stable. From wage rates higher than w_T , the labor market converges into a high-income equilibrium C, where labor income comfortably clears subsistence requirements. Once the real wage rate drops below the crucial rate w_T , the excess supply of labor drives wages down even further and forces households to expand employment. Initially this may happen through longer work hours for one parent, then for both parents, and finally by drawing on the family's children, in a futile effort to generate the family income needed for sheer survival. At some point, though, the family exhausts all its members' available work time, and employment

cannot increase any further, no matter how low the wage rate becomes. At this point the labor supply curve becomes vertical.⁶ It is in this segment, at a point such as B, where the labor demand and supply curves intersect for a new, stable equilibrium towards which the wage-trapped economy is drawn.⁷

This wage-trap equilibrium has some rather nasty characteristics:

- (i) Incomes are stuck below subsistence needs, which has consequences for the health and emotional and physical growth of family members.
- (ii) Welfare is reduced, of course, since both consumption falls and leisure time evaporates as one slides down the labor demand curve from A to B.
- (iii) There is child labor, mandated by families' struggle for survival that dominates all other considerations, causing children to receive but a minimal level of schooling, if any at all.

The route of escape from this trap would have to be technological progress and the accumulation of physical and human capital, since this would tilt the labor demand curve upward which, in turn, would eventually eliminate the wage trap. Improvement may eventually come when the labor demand curve has moved far enough, but the forces that typically foster this process are either absent or alarmingly weakened in this scenario:

- (a) There is virtually no human capital accumulation, both because adults are entirely absorbed by the struggle for survival, and because formal schooling for children is more or less absent.
- (b) There is a very high mortality rate among all generations, caused by incomes being stuck below subsistence requirements, which also inhibits human capital accumulation.
- (c) The diffusion of technological innovations from the global economy to such

⁶It has even been suggested (Dessing, 2002, p. 441) that this section is again positively-sloped rather than vertical, since families may be forced to withdraw from the formal labor market to resort to non-market, illegal or outright criminal activities to raise income. These activities range from begging and prostitution to stealing and more serious crime. We ignore this possibility, since it is not of key importance for the issues addressed here.

⁷The vertical segment of the labor supply curve is not really covered by the simple utility function proposed above, since utility is zero at any point below the subsistence curve. Thus, households are indifferent between such points. To remedy this, one might propose a separable utility function of the form $U = U(C, \bar{L} - L) \times S + u(wL - \text{MIN}) \times (1 - S)$ with $u(0) = 0$ and $u' > 0$ which makes sub-subsistence households want to approach the subsistence level.

labor markets will be possible only in rare cases, as the situation is typically characterized by very low skill levels and a high extent of equally unskilled child labor.

- (d) Factors mentioned under (a)–(c) are also detrimental to investment and the growth of the capital stock.
- (e) Though improvements in technology and human and physical capital stock may be achieved in spite of the difficulties just mentioned, these will generate only minor effects on the labor demand curve in the region where it counts in the current context. This is because such improvements typically tilt the labor demand curve upward (instead of shifting it), thus hardly affecting the position of wage trap equilibrium A.

It is these unpleasant properties of the wage-trap scenario proposed here that make us ask under what conditions such a trap may occur. With this question in mind, the remainder of the paper is organized as follows. Section 3 states the general conditions under which wage traps occur, cast in terms of the wage elasticities of labor demand and supply. Section 4 then turns to specific production functions of the kind employed in quantitative analyses of growth and development. It is revealed that a standard Cobb-Douglas production function does not permit wage traps, whereas a CES production function does.

In Section 5 the analysis is extended by relaxing some of the assumptions of “pure” scenarios. In particular, we drop the assumption of a parametric subsistence level and permit the level of income required for survival to vary with work hours. We also allow work effort or efficiency to depend on the real wage, as assumed in efficiency wage models, with rather surprising and complex results. Section 7 contains a brief discussion of policy options. Section 8 sums up and suggests questions to be addressed in future research.

3 When Do Wage Traps Occur?

As a backdrop for our analysis, this section formulates generic conditions for the occurrence of wage traps. Letting $L_S(w)$ and $L_D(w)$ denote the labor supply and demand functions, respectively, a market equilibrium w^* obtains for $L_S(w^*) = L_D(w^*)$, that is, for a real wage which equates supply and demand.

Wage traps are encountered when market equilibria are *unstable* in the sense that

excess demand is strictly increasing in the wage w . In this case, a wage rate below the market-clearing level w^* leads to an oversupply of labor, which in turn causes wages to fall even further rather than adjusting upward toward the market-clearing rate.⁸

Formally, wage traps in the definition employed here will therefore occur if

$$L'_D(w^*) > L'_S(w^*), \quad (1)$$

so that, around the market-clearing wage rate w^* , a drop in the real wage expands labor supply by more than labor demand.

It is convenient to reformulate this stability condition in terms of elasticities. Letting $\varepsilon_S(w) = L'_S(w) \cdot w / L_S(w)$ and $\varepsilon_D(w) = L'_D(w) \cdot w / L_D(w)$ denote the elasticities of labor supply and demand, respectively, condition (1) can be restated as

$$\varepsilon_D(w^*) > \varepsilon_S(w^*). \quad (2)$$

We now turn to the case where the labor market equilibrium is positioned at a point at which labor incomes hover around levels that barely support physical subsistence. In its simplest version, the subsistence-level hypothesis outlined in the introduction asserts that, for any real wage w , workers will choose labor supply so as to maintain a fixed subsistence-level of income MIN, the minimal income which a worker must obtain to remain in good health. Inverse labor supply around the subsistence level is then given by

$$L_S(w) = \text{MIN}/w.$$

The key property of this subsistence level labor supply function is that $\varepsilon_S = -1$, so that labor supply is perfectly elastic. That is, if the wage drops by 10%, workers will work exactly 10% more in order to retain the subsistence level of income. Consequently, a market equilibrium w^* will be unstable whenever

$$\varepsilon_D(w^*) > -1. \quad (3)$$

Thus, for a wage trap to occur, labor demand must be *inelastic*. A 10% drop in the wage rate must give rise to a hike in employment of *less* than 10%.

⁸This notion of stability, known as *Walrasian* stability, derives from the idea that the demand side tends to raise its wage bids when excess demand is positive whereas the supply side will lower its requested wage when excess demand is negative (see, e.g., Henderson and Quandt, 1986, Chapter 6–8).

4 Wage Traps with Cobb-Douglas or CES Production Functions

Having formulated generic conditions concerning the existence of wage traps in the previous section, we now review the scope for such traps under commonly used production functions. Given any production function $F(L)$ (and holding other factors of production fixed), competitive labor demand is determined by $L_D(w) = F'^{-1}(w)$, so that the elasticity of labor demand becomes

$$\varepsilon_D(L) = \frac{F'(L)}{F''(L) \cdot L}.$$

Cobb-Douglas Production Functions. First, consider the Cobb-Douglas production function, which is perhaps the most commonly used production function in the empirical literature on growth and development issues. For a Cobb-Douglas production function of the form $Y = F(L) = AL^\beta$ ($A > 0$, $0 < \beta < 1$),⁹ we have $F''(L) = (\beta - 1)F'(L)/L$, and hence

$$\varepsilon_D = -(1 - \beta)^{-1} < -1.$$

Thus, under a Cobb-Douglas production function, the demand for labor is always strictly elastic, implying that wage traps as sketched in Figure 2, defined as market failure, cannot occur (i.e., condition (3) will always be violated).

Sub-subsistence equilibria, such as the one which occurs at point B in Figure 2, are nevertheless possible when the production function is of the conventional Cobb-Douglas type. This occurs when technology is so poor and/or the stock of capital is so low that the labor demand curve remains below the supply curve all through the interval $0 \leq L \leq \bar{L}_{\text{all}}$. A point of intersection still exists because the demand curve is always flatter than the supply curve, and this equilibrium is indeed stable. But since this equilibrium sits outside the available range, to the right of \bar{L}_{all} , it can never be reached, and the labor market finds itself stuck below the subsistence level at B. Contrary to the situation depicted in Figure 2, however, this is not a market failure: it is rather a situation in which no market exists. If such conditions were permanent, the country or region would become deserted, or the industry would disappear. Survival of the region or industry concerned, then, is only possible if

⁹This formulation covers the usual Cobb-Douglas form $Y = \tilde{A}K^\alpha L^\beta$ since capital is held fixed in our considerations.

subsidies from outside keep it afloat for other motives.¹⁰ If such conditions are created temporarily, say in the wake of a war or a major natural disaster, with infrastructure and capital destroyed on a large scale, reconstruction support from abroad would be needed and suffice in order to return the country to a unique, stable equilibrium with labor incomes above the level of subsistence.

CES Production Functions. Next, consider the family of CES production functions of the form $F(L) = A(\tilde{K} + \beta L^{-\rho})^{-1/\rho}$. For this class of production functions, the elasticity of labor demand is

$$\varepsilon_D = -\frac{\tilde{K} + \beta L^{-\rho}}{(1 + \rho)\tilde{K}}. \quad (4)$$

For $\rho < 0$, wage traps can generally be excluded. Labor demand is always elastic since ε_D is bounded from above by $-(1 + \rho)^{-1} < -1$. For $\rho > 0$, however, ε_D increases monotonously from $-\infty$ to $-(1 + \rho)^{-1} > -1$, so that labor demand is inelastic (and wage traps are possible) for sufficiently high levels of L (low levels of MIN).¹¹

Recalling that the parameter ρ is related to the (constant) elasticity of substitution σ by $\sigma = (1 + \rho)^{-1}$, this implies that wage traps can only occur under a CES production function if the elasticity of factor substitution is less than one.

[Figure 3 near here]

Figure 3 plots a specific example in which a wage trap occurs under a CES-production function, namely for the following parameter values: $\rho = 1.5$ (implying an elasticity of substitution of $\sigma = 0.4$), $\beta = 0.5$, $\tilde{K} = 2$, $A = 30$, and $\text{MIN} = 1$.^{12,13}

¹⁰Examples include countries that subsidize living in uninhabitable areas for environmental or strategic purposes (for example high Alpine settlements or the Falklands), or industries with severe comparative disadvantages, such as agriculture, to achieve a minimum level of autarky.

¹¹Note for $\rho \rightarrow 0$ (as the CES production function approaches a Cobb-Douglas production function), ε_D^{-1} approaches $-\tilde{K}/(\tilde{K} + \beta) > -1$ (and hence becomes independent of L) for $\rho \rightarrow 0$.

¹²Strictly speaking, there is also a *stable* equilibrium at $L \approx 0.21$ that is not shown in the plot. Through the reasoning given in the introduction, in this area of relatively high leisure, consumption and high wages, we should expect labor supply to be governed by concerns other than the subsistence-level issues considered here.

¹³For this parameterization, at L^* (where supply meets demand), the share of labor income is approximately 5%, while the (non-inverse) elasticity of labor demand is approximately 0.6.

5 Robustness Checks

Given the prominent role that Cobb-Douglas production functions play in empirical research on income comparisons, growth and development, the above finding that wage traps are not compatible with such functional forms is an important one. In an effort to gauge the robustness of this result we now relax two key assumptions employed in Section 3. We first ask what happens if subsistence requirements are not parametric but depend on physical exertion and, thus, on work hours supplied. Second, we ask what are the consequences of labor productivity or work effort being dependent on the real wage rate? While both modifications may not appear urgent in analyses of industrial countries, studies of labor markets in poor, agrarian economies may be rendered unrealistic without them.

5.1 Variations on Labor Supply

Suppose the workers' subsistence-level of income MIN depends positively on the number of hours worked, so that $\text{MIN}'(L) > 0$. A plausible explanation for this may simply be that as the number of hours worked increases, the individual's calorie intake required to sustain this additional effort rises. With this modification, the inverse elasticity of labor supply is

$$\varepsilon_S = \left(-1 + \frac{\text{MIN}'(L) \cdot L}{\text{MIN}(L)} \right)^{-1} < -1.$$

Thus, the supply of labor will be strictly elastic and, as a consequence, wage traps may occur even with an *elastic* labor demand as implied by the Cobb-Douglas production function. An example with a constant employment elasticity γ of the subsistence threshold would be $\text{MIN}(L) = \lambda \cdot L^\gamma$ ($\lambda, \gamma, L > 0$). Then $\varepsilon_S^{-1} = -1 + \gamma > -1$, and the labor market features a wage trap even though the production function is Cobb-Douglas whenever $\gamma > \beta$. This functional form must be considered an approximation in the neighborhood of the labor market equilibrium, however, since it implies that the subsistence level drops to zero when households retreat from employment altogether.¹⁴

¹⁴Adding a constant to the suggested equation to obtain $\text{MIN}(L) = \lambda_0 + \lambda_1 \cdot L^\gamma$ would make the employment elasticity of the subsistence level increase with L . Then this elasticity and the wage elasticity of labor supply would have to be evaluated at the point of intersection with the labor demand curve.

5.2 Variations on Labor Demand

Suppose work effort (or efficiency) depends on the real wage rate, an assumption that is at the heart of efficiency wage models. Among many possible explanations for such a relationship the one that focuses on calorie intake and its positive impact on strength and endurance, as is the case in agrarian economies or sectors, appears particularly relevant for the issues at hand. Let the production function be

$$F(L) = A(E \times L)^\beta$$

with work effort

$$E = w^\alpha.$$

With this modification, the demand for labor is given by

$$L = (\beta A w^{\alpha\beta-1})^{\frac{1}{1-\beta}}$$

and the real-wage elasticity of labor demand is

$$\varepsilon_D = -\frac{1-\alpha\beta}{1-\beta},$$

which coincides with what we derived for the orthodox Cobb-Douglas production function in Section 4 when $\alpha = 0$. This elasticity decreases (i.e., the demand for labor schedule in a wage-employment diagram becomes steeper) when α increases. However, a wage-dependent work effort, i.e., a positive value for α , is not generally enough to generate a wage trap. Only when the elasticity of labor demand falls below -1 , the inverse wage elasticity of labor *supply* at the subsistence limit, do wage traps spring up. The condition for this to happen is obviously $\alpha > 1$. As the real wage elasticity of work effort increases still further, the labor demand curve continues to turn steeper, and eventually becomes vertical when $\alpha = 1/\beta$. At this point, the wage elasticity of income equals 1. Then any change in the real wage generates an identical change in the marginal product of labor. Thus, firms always demand the same amount of labor, no matter what the real wage rate is.

Now as α increases even beyond this threshold, the occurrence of a wage trap does not become more likely, as one might presume. This is because we are now entering efficiency-wage territory. By now the “labor demand curve” has turned positive and firms expect to increase profits by raising the wage rate, due to the fact that when the wage rate goes up the marginal productivity of labor goes up even

faster. So there is no downward spiral of the wage rate below the equilibrium point, even though the supply of labor exceeds the demand for labor at any given wage rate. Despite this excess supply, firms pay an efficiency wage that exceeds the wage demands of workers.

[Figure 4 near here]

Figure 4 may help to motivate these results. The dashed line is the labor demand curve that derives from the conventional Cobb-Douglas production function. This curve obtains when $\alpha = 0$ and it is flatter than the subsistence-level labor demand curve. Thus the labor market equilibrium is stable. As α increases, the labor demand curve turns steeper than the labor supply curve and the labor market is unstable, and wage trapped. When α crosses the second threshold $\alpha = 1/\beta$, the labor demand curve turns out of the shaded region, and its slope becomes positive. Now profits increase as we slide up the labor demand curve, and firms voluntarily pay wages that exceed the subsistence level.

So the result of this section is quite complex: wage-dependent work effort may indeed be the cause of wage traps even though the production function is the Cobb-Douglas and the subsistence level is parametric. But for a wage trap to occur and be operational, the wage elasticity of work effort must be in the zone $1 < \alpha < 1/\beta$. Outside this zone the equilibrium either remains stable, or firms pay efficiency wages despite an apparent excess supply of labor.

In judging the empirical relevance of this condition, we note that it is less demanding than the condition required by efficiency-wage models, which is $\alpha > 1/\beta$. For a wage trap to occur, we need a weaker response of work effort to changes in the real wage rate than efficiency-wage models do.

As a further refinement, again with an eye on conditions characteristic of employment in agriculture, let work effort not only rise with the real wage, but also decline with work hours as workers tire. Then

$$E = \frac{w^\alpha}{L^\delta},$$

and the wage elasticity of labor demand changes to

$$\varepsilon_D = -\frac{1 - \alpha\beta}{1 - (1 - \delta)\beta}.$$

This leaves the upper limit for α to generate wage traps unaffected, but lowers the lower limit. Wage traps now occur when the real-wage elasticity of work effort is in the wider range of $1 - \delta < \alpha < 1/\beta$.

6 A survey of pertinent empirical work

Before we proceed to look at the policy options available to governments and international organizations confronted with wage trap scenarios of one kind or other, we pause to look at what pertinent empirical studies say about the relevance of what we are discussing here.

The key question is whether an outward-sloping segment of the labor supply curve is merely a theoretical construct or a phenomenon that is actually encountered in reality. In a nutshell, available results suggest that, while it may be stretching things to conclude that 'the forward-falling labor supply is at the least becoming a new stylized fact.' [Nakamura and Murayama (2009)], a substantial body of empirical evidence exists of negative wage (or income) elasticities of labor supply available at early stages of economic development.

The empirical literature up until the mid-1990s has been surveyed by Sharif (2000). From the available empirical work on the labour supply of poor workers at low standards of living both in developing and in industrialized countries, he concludes: 'Almost all the empirical studies observe that their labour supply at very low wage rates is a negatively sloping (forward-falling) function. However, studies that distinguish very low from moderately low wages report two types of supply function - a negatively sloped one at very low wages and a positively sloped one at moderately low wages' (p. 431).

Later and recent work finds further evidence of 'anomalous' labor supply behaviour. Studies that look at the labour supply of families include Sharif (1991) and Pradhan and van Soest (1997). Looking at Indian data, Sharif finds that while the wage elasticity of male work hours changes from positive to negative as we move towards lower wages, these elasticities are always negative for women and even more negative for children. Pradhan and van Soest (1997) conclude from their analysis of Bolivian data that females work more when their husbands earn less.

Another body of work looks at those family members expected to have the most flexible supply of work hours. Looking at India, Dasgupta and Goldar (2005) identify a significantly outward-sloping labour supply for women when their households are below some poverty threshold. More indirect evidence in line with the hypothesis of an outward-sloping supply curve is provided by Mammen and Paxson (2000). After studying data for 90 countries, they find that female participation rates are U-shaped during a countries development. As long as the country is poor, participation rates

recede when per-capita incomes grow. Beyond a certain threshold, participation rates rise again when per-capita incomes continue to grow.

Other studies look at child labour and work hours of older household members. Jensen and Nielsen (1997) for Zambia and Blunch and Verner (1999) for Ghana report a direct relationship between poverty and child labour, while Edmonds (2006) finds that children in South African households with one member that collects some sort of pension have a higher probability of attending school. Finally, Sawant (2009) reports a negative correlation between the wage rate and the labour supply of older people in Indonesia.¹⁵

The lesson to be drawn from available empirical evidence is that outward-sloping segments are features of the labour supply curve that are indeed encountered in the real world. Not always, but quite frequently. And not only in developing economies, but on occasion in certain industries or income brackets of industrialized countries also. Such negative wage elasticities are a necessary conditions but not sufficient ones for wage traps, of course. Elasticity estimates encountered in econometric work, however, provide a first clue as to which of the wage trap scenarios, or sufficient conditions, discussed in section 2 may be the most relevant in reality. The fact that elasticities, even when negative, do not drop below -1 , rules out case the scenario discussed in section 5.1 (the combination of simple Cobb-Douglas and a subsistence level the rises with employment) and leaves the cases discussed in sections 4 and 5.2 as the scenarios to look for in future empirical work.¹⁶

We next look at policy options available when a country or industry is stuck in a wage trap.

7 Policy Measures

Section 2 provided a glimpse at the rather unpleasant properties of wage-trap equilibria in the labor market, and the negative effect this has on development prospects. The natural question to ask now is what can be done once such a trap is diagnosed.

¹⁵It appears well worth noting that evidence of outward-sloping labor supply curves at low levels of income is not only found in developing countries, but, though less often, in industrialized countries as well. See Dessing (2008) and the example reported by Camerer et al. (1997) that New York City cab drivers “set a loose daily income target and quit working once they reach that target.” Wage elasticities average approximately -1 .

¹⁶For one specific example, Dessing (2002) reports wage elasticities of household labour supply in the Philippines derived from OLS estimates of -0.554 .

This section looks at a few structural measures from the toolbox of labor market and development policies. It indicates that if the culprit behind a poverty trap is a wage-trapped labor market, measures traditionally suggested in the literature on poverty traps in models of economic growth should not be overlooked, but should be supplemented by labor market instruments for quicker results or temporary relief. Regarding these labor market instruments, we also see that in the presence of wage traps, conventional wisdom on labor market policy is often turned on its head.

Foreign aid. Standard measures of development aid in terms of grants or long-term loans at favorable interest rates, earmarked for investment in infrastructure, technology, education or private investment subsidies, would mainly target the labor demand curve. Effects from such measures may take a long time to materialize. Also, help needs to be substantial in order to push the economy out of the wage-trap region, similar to big-push proposals advanced in the context of conventional poverty traps such as those that derive from inadequate savings rates at low income levels. And, as already mentioned in Section 2, effects may be rather small in the very region where the low labor-income equilibrium is positioned, since the productivity of child labor may not respond very strongly to capital accumulation and the influx of established technology from the global economy. Other help, in kind or in money, that covers at least part of the subsistence gap in labor income, may improve the situation for families and their children during the time needed to move out of the wage trap, and in fact, may speed things up by making aid conditional on children returning to schools.

A ban on child labor.

[Figure 5 near here]

Consider Figure 5. Suppose that all available family labor, including child labor, is exhausted at \bar{L}_{all} . Then the sub-subsistence equilibrium is at point B and the family's labor income falls short of subsistence needs by an amount measured by the shaded area D. Now let available adult labor be \bar{L}_{adult} . Then the effect of an outright ban on child labor, say through domestic legislation, is to move the sub-subsistence equilibrium to point B'. In addition to the primarily targeted elimination of child labor and improved schooling, this has the added benefit of moving family incomes

closer to subsistence requirements. The subsistence deficit in labor incomes has shrunk from the shaded area D to area D'.¹⁷

Minimum wages. Simply instituting the minimum wage rate w' can generate the same aggregate outcome that results from a ban on child labor. Underneath aggregate numbers, however, it is uncertain that it is exclusively or even predominantly children who drop out of employment when labor demand falls. On the other hand, minimum wages could even lift the labor market out of the wage trap entirely and restrict it to a range where market forces work properly. Setting the minimum wage rate only slightly above the threshold w_T would make firms bid up wage rates until they reach w_{HI} . At this wage rate, child labor would become extinct,¹⁸ there would be no unemployment and, perhaps most importantly, labor income would sit comfortably above the level of subsistence.

Trade unions. Labor unions with sufficient monopoly power can set wage rates at any desired level, while leaving it up to firms to decide how much labor they want to employ at that price. Typically, such a trade union would demand a wage rate above w_{HI} , just as any monopolist would set prices higher than the level obtained under perfect competition. This would prevent the labor market from falling into the wage trap: it effectively removes incentives for child labor and raises labor income far above the subsistence level. The downside of this institutional change would probably be a certain amount of involuntary unemployment.

Fair trade agreements. When properly set up, monitored and enforced, fair trade agreements can achieve the same results as national legislation banning child labor, or setting minimum wages, and can also help establish trade unions or give them more leverage.

¹⁷A sufficient condition for $D' < D$ is that, for any $L > \bar{L}_{adult}$, the labor demand curve is steeper than the supply curve. This is always met with the constant-elasticity specifications used in most parts of this paper. Necessary conditions are much weaker, of course. Nevertheless, functional forms that do not support this result may exist.

¹⁸Here, we assume that parents make their children drop out of school and work only when pressured by sub-subsistence incomes.

8 Summary and Outlook

When work incomes hover around subsistence levels, further cuts in wage rates may force families to increase their supply of labor. If, in addition, the elasticity of this labor supply with respect to the real wage rate exceeds the wage elasticity of labor demand, equilibria on this outward-sloping segment of the labor supply curve are unstable and labor incomes may end up trapped at or below subsistence levels. Additional unpleasant properties of such degenerated equilibria include adult illiteracy, child labor and a far-ranging detachment from global development trends.

Fortunately, when turning to specific functional forms with proven empirical credentials, generic conditions for wage traps are not met when the production function is Cobb-Douglas and income levels required for survival are exogenous. However, the more general CES production function does permit wage traps under quite plausible parameter scenarios.

Beyond our reference setting, features that render wage traps more likely are endogenous subsistence levels that increase with work time, and work effort (or labor productivity) that is positively related to wage rates, as proposed in efficiency wage theory. Both of these features are often encountered in poor countries with dominant agricultural sectors, where the physical aspects of work prevail. Interestingly though, the influence of the wage elasticity of work effort on the occurrence of wage traps is not monotonic. The effect is positive only up to a certain threshold. Once we go beyond this point to enter efficiency-wage territory, the wage trap disappears because profit-maximizing firms pay higher wage rates voluntarily.

Wage-trapped economies may benefit from policy measures that tend to be snubbed by from conventional labor market analysis. A ban on child labor has the added benefit of reducing the subsistence gap in family incomes. Minimum wage laws have the same effect when implemented modestly, and can even raise the labor market out of the wage trap entirely when the minimum is set high enough. The definitive remedy for wage traps are trade unions with a sufficient degree of market power. But this comes at a price, since it has the side effect of some involuntary unemployment. Consumers in the rich part of the world can play an important role in this process by favoring products certified by fair trade agreements which enforce standards that include all or some of the above policies.

This paper has taken a more or less isolated look at the labor market and has omitted empirical issues altogether. Future work will have to remedy this. This can

be done first by putting wage traps in macroeconomic context in order to properly address issues of growth and development with a special focus on poverty traps, and then by looking at available policy choices and their national and global repercussions.¹⁹ Secondly, this can be accomplished by exploring the empirical relevance of wage trap scenarios. Quite a number of empirical findings and statistics exist that are well in line with the properties of a wage-trapped labor market, and point to the relevance and potential benefits of studying such scenarios. Examples are the many studies that detect a substantial increase in employment when already low wage rates drop further;²⁰ or estimates that about one billion people worldwide and almost half the population in regions such as the Indian subcontinent or sub-Saharan Africa must live on less than 1 Dollar a day (World Bank, 2007, p. 65). As a compelling sign that such incomes fall way short of subsistence requirements, a similar percentage of children are underweight in many of these countries (World Bank, 2007, p. 67). In addition, child labor abounds and a high percentage of children do not receive a formal primary education.²¹ While these are but isolated pieces of evidence, they feed into a more complete assessment that needs to be developed.

¹⁹This would fit into a research agenda initiated by Agénor (2005), who advocates a shift away from an “excessive focus on micro and measurement issues” towards a “macroeconomics of poverty reduction” (p. 349).

²⁰Representative examples of older and more recent empirical studies that detect positive employment responses to falling wage rates in low income sectors or countries include Miracle (1976) for African regions, Rosenzweig (1980) for India, Hernández-Licona (2000) for Mexico, and Dessing (2002) for the Philippines.

²¹In sub-Saharan Africa, an estimated 69 million or 35 percent of all children aged 5–14 work, and 41 million of these children are out of school (Unicef, 2007, pp. 12 and 44).

References

- Agénor, Richard-Pierre (2005) ‘The macroeconomics of poverty reduction.’ *The Manchester School* 73(4), 369–434
- Azariadis, Costas (1996) ‘The economics of poverty traps.’ *Journal of Economic Growth* 1(4), 449–496
- (2004) ‘The theory of poverty traps: What have we learned?’ In *Poverty Traps*, ed. S. Bowles, S. Durlauf, and K. Hoff
- Azariadis, Costas, and John Stachurski (2005) ‘Poverty traps.’ In *Handbook of Economic Growth*, ed. Philippe Aghion and Steven Durlauf, vol. 1 chapter 5, pp. 295–384
- Barzel, Yoram, and Richard J. McDonald (1973) ‘Assets, subsistence, and the supply curve of labor.’ *American Economic Review* 63(4), 621–633
- Basu, Kaushik, and Pham Hoang Van (1999) ‘The economics of child labor: reply.’ *American Economic Review* 89(5), 1386–1388
- Blunch, Nils-Hugo, and Dorte Verner (1999) ‘Revisiting the link between poverty and child labor: the ghanaian experience.’ World Bank Policy Research Working Paper No. 2488
- Camerer, Colin, Linda Babcock, and Richard H. Thaler (1997) ‘Labor supply of new york city cabdrivers: one day at a time.’ *Quarterly Journal of Economics* 112(2), 408–441
- Dasgupta, Purnamita, and Bishwanath Goldar (2005) ‘Female labour supply in rural India: an econometric analysis.’ Mimeo, Institute of Economic Growth, Delhi University
- Dessing, Maryke (1990) ‘The urban informal sector in developing countries: labor supply and the family.’ Ph.D. Dissertation, The Graduate Institute of International Studies in Geneva, Department of Economics, Geneva
- (2002) ‘Labor supply, the family and poverty: The S-shaped labor supply curve.’ *Journal of Economic Behavior & Organization* 49(4), 433–458

- (2008) ‘The S-shaped labor supply schedule: evidence from industrialized countries.’ *Journal of Economic Studies* 35(8), 445–485
- Edmonds, E. V. (2006) ‘Child labor and schooling responses to anticipated income in South Africa.’ *Journal of Development Economics* 81(2), 386–414
- Grimsrud, Bjørne (2003) ‘Millennium development goals and child labour.’ Understanding Children’s Work project report
- Henderson, James E., and Richard E. Quandt (1986) *Microeconomic Theory* (Singapore: McGraw Hill)
- Hernández-Licona, Gonzalo (2000) ‘Reshaping the labour supply curve for the poor.’ Mimeo
- Jensen, P., and H. S. Nielsen (1997) ‘Child labor or school attendance? evidence from Zambia.’ *Journal of Population Economics* 10(4), 407–424
- Kraay, Aart, and Claudio Raddatz (2006) ‘Poverty traps, aid, and growth.’ *Journal of Development Economics* 82(2), 315–347
- Krueger, Anne O. (1962) ‘The implications of a backward bending labor supply curve.’ *Review of Economic Studies* 29(4), 327–328
- Lin, Chung-Cheng (2003) ‘A backward-bending labor supply curve without an income effect.’ *Oxford Economic Papers* 55(2), 336–343
- Mammen, K., and C. Paxson (2000) ‘Women’s work and economic development.’ *Journal of Economic Perspectives* 14(4), 141–164
- Miracle, Marvin P. (1976) ‘Interpretation of backward-sloping labor supply curves in Africa.’ *Economic Development and Cultural Change* 24(2), 399–406
- Nakamura, Tamotsu, and Yu Murayama (2009) ‘A complete characterization of the inverted S-shaped labor supply curve.’ *Metronomica* 14(4), 141–164
- Pradhan, R., and A. van Soest (1997) ‘Household labor supply in urban areas of Bolivia.’ *Review of Economics and Statistics* 79(2), 300–310
- Prasch, Robert E. (2000) ‘Reassessing the labor supply curve.’ *Journal of Economic Issues* 34(3), 679–691

- Rosenzweig, Mark R. (1980) 'Neoclassical theory and the optimizing peasant: An econometric analysis of market family labor supply in a developing country.' *Quarterly Journal of Economics* 94(1), 31–35
- Samuelson, Paul (1947) *Foundations of economic analysis* (Boston, Mass: Harvard University Press)
- Sawant, Ksama (2009) 'Elderly labor supply in a rural, less developed economy: an empirical study.' Ph.D. dissertation, North Carolina State University
- Sharif, Mohammed (1991) 'Poverty and the forward-falling labor supply function: A microeconomic analysis.' *World Development* 19(8), 1075–1093
- (2000) 'Inverted "S" - the complete neoclassical labour supply function.' *International Labour Review* 139(4), 409–434
- (2003) *Work Behavior of the World's Poor* (Ashgate: Aldershot, UK)
- Swinnerton, Kenneth A., and Carol Ann Rogers (1999) 'The economics of child labor: comment.' *American Economic Review* 89(5), 1382–1385
- Unicef (2007) 'Progress for children: A world fit for children.' Statistical Review (No. 6), December
- World Bank (2007) *Global Monitoring Report 2007—Millennium Development Goals: Confronting the Challenges of Gender Equality and Fragile States* (Washington D.C.: World Bank Publications)

Figure 1

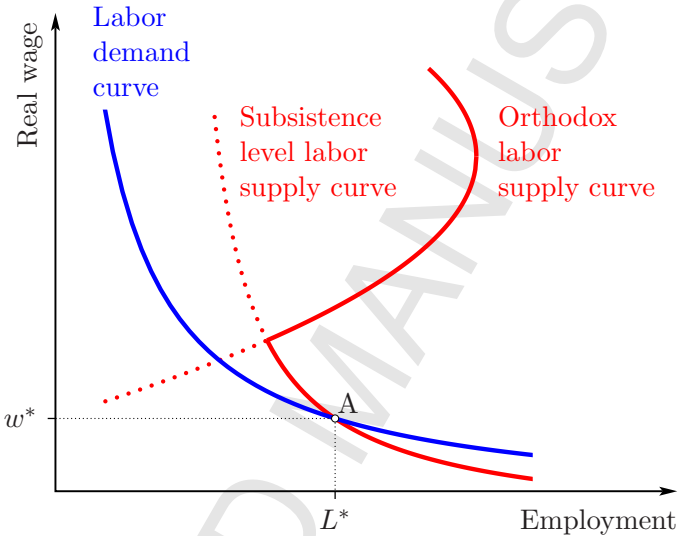


Figure 1: A Stable Labor Market Equilibrium with Outward-Sloping Supply.

Figure 2

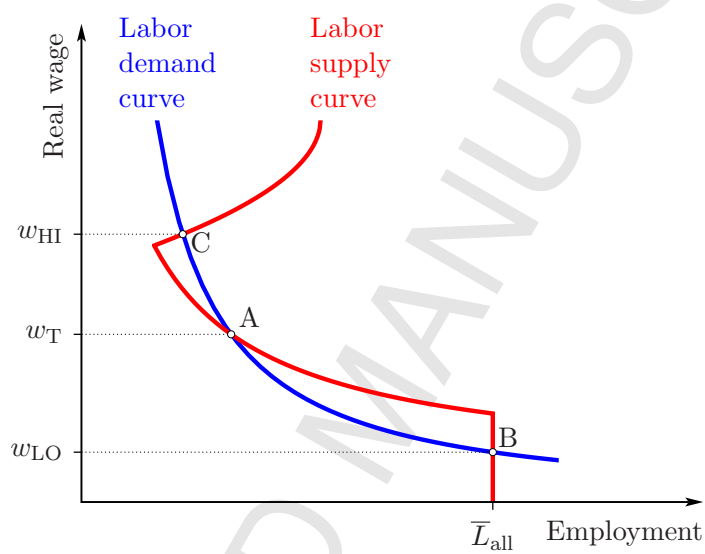


Figure 2: Multiple Equilibria and a Wage-Trapped Labor Market with Outward-Sloping Supply.

Figure 3

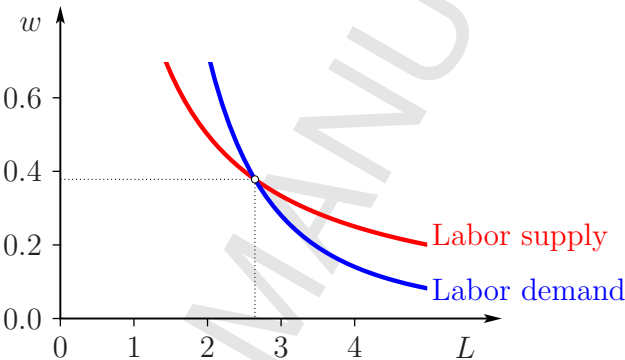


Figure 3: A Wage-Trapped Labor Market with a CES-Production Function.

Figure 4

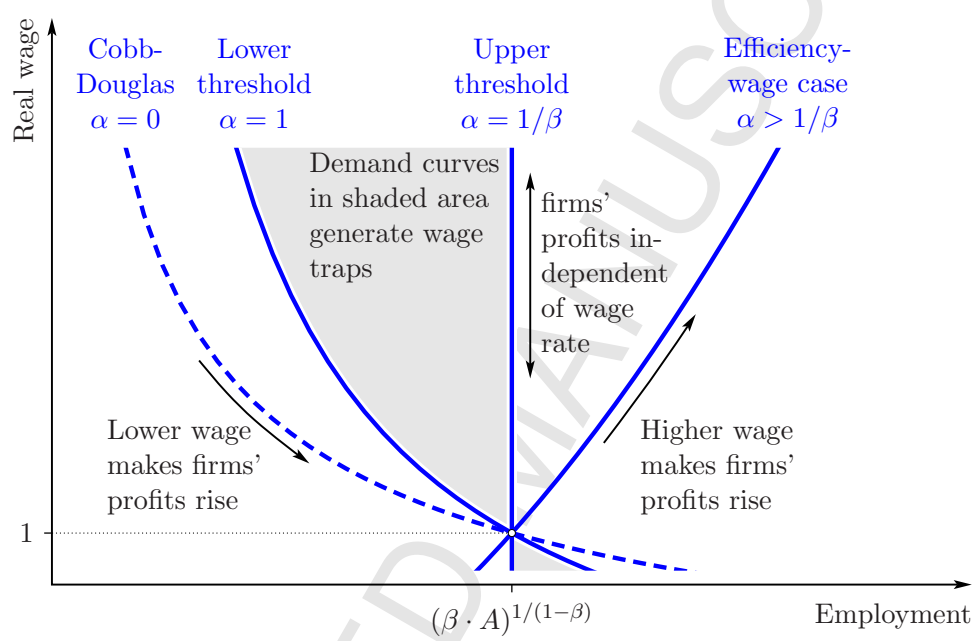


Figure 4: The Wage Elasticity of Work Effort and the Slope of the Labor Demand Curve.

Figure 5

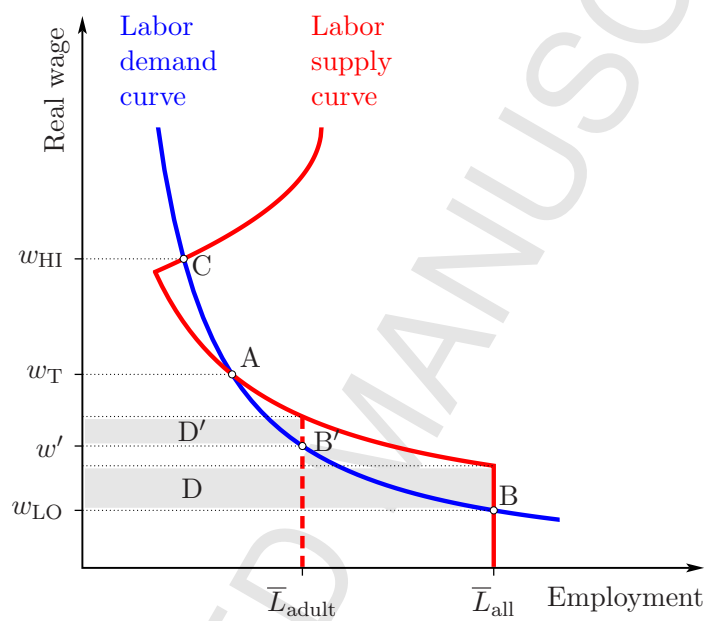


Figure 5: Policy Measures in a Wage-Trapped Labor Market: A Ban on Child Labor.

Research Highlights

- This paper explores conditions under which near-subsistence labor incomes imply wage traps.
- Wage traps are labor market failures that can cause undernourishment, illiteracy, and child labor.
- Orthodox Cobb-Douglas production functions do not permit wage traps.
- Cobb-Douglas functions featuring work effort that rises with the wage rate do permit wage traps, and so do CES functions.
- Bans on child labor, minimum wage laws, or labor unions may quite improve conditions in wage trapped labor markets.